

REMARKS

Claims 1 and 3 have been amended in order to more particularly point out, and distinctly claim the subject matter to which the applicants regard as their invention. The applicants respectfully submit that no new matter has been added. It is believed that this Amendment is fully responsive to the Office Action dated July 13, 2004.

Claim Rejections under 35 USC §102

Claims 1, 2, 5 and 6 are rejected under 35 USC §102(b) as being anticipated by Japanese Patent 11-063694 to Suzuki.

The present invention is a refrigerator in which two embodiments are described. The first embodiment is shown in Figure 1 and recited in claims 1, 2, 5 and 6 and the second embodiment is shown in Figure 3 and recited in claims 3 and 4. The first embodiment consists of a compressor (21), a radiator (22), an evaporator (24). A temperature sensor (28) is placed on the line leading from the compressor (21) and measures temperature of the carbon dioxide refrigerant leaving the compressor (21). A control unit (29) is connected to the temperature sensor (28) and is also connected to a second throttle valve (27). As indicated on page 7, lines 9-18, the discharge gas temperature from the compressor (21) is measured by the temperature sensor (28) and when the temperature exceeds a preset temperature the control unit (29) opens the second throttle valve (27) which permits refrigerant in a supercritical state flowing out of the radiator (22) to be injected into the cylinder of the compressor (21).

Japanese Patent 11-063694 to Suzuki describes a refrigeration cycle. According to the abstract, the Suzuki invention includes a compressor (2), a radiator (3), an evaporator (7) and a gas liquid separator (5). A sensor (10) is attached to the gas liquid separator (5) which is in turn connected to a control unit (11). The control unit (11) is also connected to a first throttle valve (4). A bypass passage (9) leads from the gas liquid separator (5) to the compressor (2).

The bypass passage (9) in Japanese Patent Application Laid-open No. 11-063694 is provided at a side more downstream than the first throttle valve (4). This bypass passage (9) is connected to the gas liquid separator (5), so that a gas refrigerant separated by the gas liquid separator (5) is allowed to flow.

To the contrary, the injection pipe in the present invention is provided at a side more upstream than the (first) throttle apparatus (23). That is, the injection pipe in the present invention is a pipe branched off from a pipe between an outlet of the radiator and an inlet of the first throttle apparatus. Further, the injection pipe is connected directly to the cylinder of the compressor not via an apparatus (or a receiver) for separating gas and liquid from each other, which is different from the cited references.

As mentioned above, the injection pipe in the present invention is branched off from a pipe located ahead of the throttle apparatus, and does not have a gas liquid separator. By leading the refrigerant in the supercritical state directly into the cylinder, the discharging temperature of the compressor can be lowered even with a small amount of the refrigerant, and problems such as liquid compression are not caused.

Therefore, independent claim 1 patentably distinguishes over the prior art relied upon by reciting,

“A refrigerator wherein at least a compressor, a radiator, a first throttle apparatus and an evaporator are connected to one another in an annular form to constitute a main circuit of a refrigeration cycle, a refrigerant which can be brought into a supercritical state by said radiator during operation is charged into said refrigeration cycle, an injection pipe branched off from a pipe between an outlet of said radiator and an inlet of said first throttle apparatus is connected to a cylinder of said compressor not via a receiver for separating gas and liquid from each other, and the refrigerant in the supercritical state is injected into said cylinder of said compressor.” (Emphasis Added)

Therefore, withdrawal of the rejection of Claims 1, 2, 5 and 6 under 35 USC §102(b) as being anticipated by Japanese Patent 11-063694 to Suzuki.

Claims 3 and 4 are rejected under 35 USC §102(b) as being anticipated by Japanese Patent application 2001-296067 to Ishida et al.

The second embodiment of the present invention is shown in Figure 3 and described on pages 8-13 of the specification. The second embodiment of the present invention includes a compressor (21), an outdoor heat exchanger (31) and an indoor heat exchanger (32). A temperature sensor (28) is placed on the line leading from the compressor (21) and measures temperature of the carbon dioxide refrigerant leaving the compressor (21). A control unit (29) is connected to the temperature sensor (28) and is also connected to a second throttle valve (27). As indicated on page 10, lines 21-31, the discharge gas temperature from the compressor (21) is measured by the temperature sensor

(28) and when the temperature exceeds a preset temperature the control unit (29) opens the second throttle valve (27) which permits refrigerant in a supercritical state flowing out of the outdoor heat exchanger (31) to be injected into the cylinder of the compressor (21).

Japanese Patent application 2001-296067 to Ishida et al. describes a refrigerator system using carbon dioxide as a refrigerant. According to the abstract, the Ishida et al. invention includes a compressor (1), an inside heat exchanger (8) and a gas liquid separator (7). According to the abstract, it appears that a rise in the discharge temperature of the compressor is controlled by gas injection mechanism E leading from the gas liquid separator (7) to the compressor (1).

The gas injection mechanism E in Japanese Patent Application Laid-open No. 2001-296067 is provided at a side more downstream than the expansion valve (11). This gas injection mechanism E is connected to the receiver (7), so that a gas refrigerant separated by the receiver (7) is allowed to flow.

As previously discussed, the injection pipe in the present invention is provided at a side more upstream than the (first) throttle apparatus (23). That is, the injection pipe in the present invention is a pipe branched off from a pipe between an outlet of the radiator and an inlet of the first throttle apparatus. Further, the injection pipe is connected directly to the cylinder of the compressor not via an apparatus (or a receiver) for separating gas and liquid from each other, which is different from the cited references.

As mentioned above, the injection pipe in the present invention is branched off from a pipe located ahead of the throttle apparatus, and does not have a gas liquid separator. By leading the

refrigerant in the supercritical state directly into the cylinder, the discharging temperature of the compressor can be lowered even with a small amount of the refrigerant, and problems such as liquid compression are not caused.

Therefore, independent claim 3 patentably distinguishes over the prior art relied upon by reciting,

“A refrigerator wherein at least a compressor, a four-way valve, an outdoor heat exchanger, a first throttle apparatus and an indoor heat exchanger are used as constituent elements for constituting a main circuit of a refrigeration cycle, a refrigerant which can be brought into a supercritical state by said outdoor heat exchanger or said indoor heat exchanger during operation is charged into said refrigeration cycle, a pipe branched off from a pipe between said outdoor heat exchanger and said first throttle apparatus not via a receiver for separating gas and liquid from each other is provided with a first check valve, a pipe branched off from a pipe between said indoor heat exchanger and said first throttle apparatus not via a receiver for separating gas and liquid from each other is provided with a second check valve, a downstream pipe of said first check valve and a downstream pipe of said second check valve are merged with each other and connected to a cylinder of said compressor, said first check valve and said second check valve are provided such that the refrigerant only flows toward said cylinder of said compressor, the refrigerant in the supercritical state is injected into said cylinder of said compressor from said pipe between said outdoor heat exchanger and said first throttle apparatus or said pipe between said indoor heat exchanger and said first throttle apparatus.”
(Emphasis Added)

Therefore, withdrawal of the rejection of Claims 3 and 4 under 35 USC §102(b) as being anticipated by Japanese Patent application 2001-296067 to Ishida et al. is respectfully requested.

Conclusion

In view of the aforementioned amendments and accompanying remarks, claims 1 and 3, as amended, are in condition for allowance, which action, at an early date, is requested.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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